

# Claims

[c1] What is claimed is:

1. A system for controlling an ignition system comprising:

an engine having at least one combustion chamber;

a spark plug disposed within the at least one combustion chamber; and

an engine control unit (ECU) configured to commence a multi-spark event of the spark plug , detect combustion, and discontinue the multi-spark event upon detection of combustion in the at least one combustion chamber.

[c2] 2. The system of claim 1 wherein the ECU is further configured to compare a current between a pair of electrodes disposed within the combustion chamber before the execution of the multi-spark event and a current between the pair of electrodes after an execution of the multi-spark event to detect a conductivity indicative of combustion.

[c3] 3. The system of claim 2 wherein the conductivity indicative of combustion is detected if the current between the pair of electrodes after the execution of the multi-spark event is greater than the current between the pair

of electrodes before an execution of the multi-spark event.

- [c4] 4. The system of claim 2 wherein the ECU is further configured to allow the spark plug to execute the multi-spark event until one of the current indicative of combustion is detected between the pair of electrodes and a predetermined duration of the multi-spark event has expired.
- [c5] 5. The system of claim 1 wherein the ECU is configured to discontinue the multi-spark event if the conductivity detected is indicative of an increase in ion concentration within the combustion chamber.
- [c6] 6. The system of claim 1 further comprising a capacitor to store a voltage potential, wherein the capacitor is configured to deliver a stored voltage potential to supply the spark plug with a voltage potential to execute the multi-spark event.
- [c7] 7. The system of claim 6 wherein the system is further configured to dump a remaining stored voltage potential after the ECU discontinues the multi-spark event.
- [c8] 8. The system of claim 6 further comprising a switching circuit configured to discharge the stored voltage potential for a first combustion chamber to a spark plug of

another combustion chamber after the ECU discontinues the multi-spark event in the first combustion chamber.

[c9] 9. The system of claim 8 wherein the switching circuit is further configured to switch delivery of the stored voltage potential while the capacitor is charged with the stored voltage potential.

[c10] 10. The system of claim 1 wherein the ECU is further configured to execute the multi-spark event during a stratified combustion mode in the combustion chamber.

[c11] 11. The system of claim 1 incorporated into one of an outboard motor, an inboard motor, an all terrain vehicle engine, a motorcycle engine, a scooter engine, a snowmobile engine, and a lawn equipment engine.

[c12] 12. The system of claim 2 wherein the pair of electrodes is a pair of spark plug electrodes.

[c13] 13. The system of claim 2 wherein the pair of electrodes is independent of a pair of spark plug electrodes.

[c14] 14. A method of controlling a multi-spark ignition system comprising the steps of:  
(A) determining a first ion concentration within a combustion chamber of a marine engine;  
(B) firing an ignition spark of a multi-spark event into

the combustion chamber;

(C) monitoring subsequent ion concentration within the combustion chamber; and

(D) disabling subsequent ignition sparks of the multi-spark event if the ion concentration within the combustion chamber is indicative of a fuel ignition, otherwise repeating steps (B) through (C).

[c15] 15. The method of claim 14 further comprising the step of discharging a stored voltage potential to cause the firing of the ignition spark.

[c16] 16. The method of claim 14 further comprising the step of discharging a stored voltage potential from a capacitor to another combustion chamber if the ion concentration within the combustion chamber is indicative of fuel ignition.

[c17] 17. The method of claim 14 wherein monitoring an ion concentration comprises the step of determining a current induced by a voltage potential between a pair of electrodes.

[c18] 18. The method of claim 17 wherein an increase in the current induced by the voltage potential between the pair of electrodes is indicative of fuel ignition within the combustion chamber.

[c19] 19. An outboard motor comprising:  
a powerhead having an internal combustion engine, a midsection configured for mounting the outboard motor to a watercraft, and a lower unit powered by the internal combustion engine to propel a watercraft, the engine having at least one combustion chamber;  
at least one spark plug operationally disposed within the at least one combustion chamber to execute a multi-spark event;  
a pair of electrodes disposed within the at least one combustion chamber and having a voltage potential therebetween; and  
an ECU configured to commence the multi-spark event by repeatedly sparking the spark plug and discontinue the multi-spark event if a current indicative of combustion between the pair of electrodes within the combustion chamber is detected during the multi-spark event.

[c20] 20. The outboard motor of claim 19 wherein the ECU determines a first current prior to the multi-spark event and a second current during execution of the multi-spark event, and wherein if the second current is greater than the first current, the ECU indicates a conductivity indicative of combustion.

[c21] 21. The outboard motor of claim 20 wherein the second

current induced during the multi-spark event is induced between ignition sparks of the multi-spark event.

[c22] 22. The outboard motor of claim 20 wherein the pair of electrodes is a pair of auxiliary electrodes.

[c23] 23. The outboard motor of claim 20 wherein the at least one spark plug includes the pair of electrodes.

[c24] 24. The outboard motor of claim 19 wherein the engine further comprises a storage device to supply the at least one spark plug with a voltage potential to execute the multi-spark event and a switching circuit to transfer an output of the storage device to at least one other spark plug disposed in at least one other combustion chamber when the multi-spark event is discontinued.

[c25] 25. The outboard motor of claim 21 wherein the conductivity indicative of combustion is detected if the second current is greater than the first current by greater than a threshold value.